# PRELIMINARY SOILS INVESTIGATION

# KAILUA HEIGHTS SUBDIVISION UNIT 6-B

# KAILUA, OAHU, HAWAII

for

## HAWAIIAN PACIFIC INDUSTRIES, INC.

T.M.K - 4-2-78

April 6, 1972

W.O. 140

ERNEST K. HIRATA & ASSOCIATES, INC.

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering
1157 South King Street • Honolulu, Hawaii 96814 • Phone 533-6529

April 6, 1972
W.O. 140

Hawaiian Pacific Industries, Inc.
1020-E Keolu Drive
Kailua, Oahu, Hawaii 96734

Attention: Mr. William Rus

Gentlemen:

The following report titled "Preliminary Soils Investigation, Kailua Heights Subdivision Unit 6-B, Kailua, Oahu, Hawaii," dated April 6, 1972 our work order 140 is enclosed.

This investigation was authorized to determine the subsurface soil conditions at the site and to determine if any unusual or adverse soil condition might exist which would affect the proposed development.

We found that the surface soils on the two ridges are comprised of a layer of silty clay averaging two feet in thickness. Underlying the surface soil was weathered rock classified as clayey silts grading to hard rock with depth. The lower areas adjacent to the existing subdivision were composed of a surface layer of brown silty clay underlain my mottled yellow weathered rock. The weathered rock was found to be very hard.

The site is feasible for the proposed development provided the recommendations in this report are followed.

We appreciate the opportunity to be of service. Should you have any questions concerning this report, please call on us.

Very truly yours,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata

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# PRELIMINARY SOILS INVESTIGATION
# KAILUA HEIGHTS SUBDIVISION UNIT 6-B
# KAILUA, OAHU, HAWAII

## INTRODUCTION

This report presents the results of our soils investigation conducted on the subject property. The scope of this investigation was planned in collaboration with Mr. Calvin Kim of VTN Pacific. This investigation was authorized to determine the subsurface soil conditions at the site and to provide recommendations for the housing development.

## SITE DESCRIPTION

This investigation encompasses approximately 12 acres of land along the northwestern ridges of Kailua Heights. Topographically, the site includes portions of two ridges overlooking Aukele and Loho Streets.

The total relief for the proposed subdivision will be approximately 160 feet. The entire site is covered with a moderate to heavy growth of trees and brush.

Groundwater was not encountered in any of the exploratory borings nor was surface water observed on the site.

## PROPOSED GRADING

The proposed subdivision will include 49 lots. Grading techniques of cutting and filling will be utilized to develop pad areas and proper drainage. Cut slopes are planned at slope gradients of 1:1 and 1½:1 while fill slopes are planned at 2:1 slope gradients.

The maximum height of fill slopes is not expected to exceed 30 feet vertically, while the maximum height of cut slope is not expected to exceed 110 feet.

The maximum vertical thickness of cut will be about 40 feet, while the maximum vertical thickness of fill will be on the order of 30 feet.

Sewers are planned to handle the sewage disposal for the proposed development.

## FIELD EXPLORATION

Field exploration was performed on March 13, 1972 using a truck mounted rotary drill rig. In addition, visual examination was made of the exposed slope facing Kina Street. The soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System.

Undisturbed and bag samples were recovered from the borings for laboratory testing. Undisturbed samples were obtained by driving a split tube sampler with a 140 pound hammer from a height of 30 inches. The required blow count for each 6 inches of penetration is shown on the enclosed Boring Logs.

## LABORATORY TESTING

Laboratory testing was performed on the undisturbed and bag samples. Laboratory tests include Atterburg Limits, moisture density relationships, consolidations, compactions, swells, and shears. Test results and testing procedures are described in the attached Appendix.

## SOIL CONDITIONS

Results of the subsurface investigation indicate that the two ridges are comprised of a surface layer of silty clay averaging two feet in thickness. Underlying the surface soil was weathered rock classified as clayey silts grading to hard rock with depth. The lower areas adjacent to the existing subdivision were composed of a surface layer of brown silty clay underlain by mottled yellow weathered rock.

Very few undisturbed samples were recovered from the weathered rock due to its hardness.

## ENGINEERING ANALYSES

### I. Slope Stability

A. Fill Slopes: Laboratory test results on the remolded samples indicate that fill slopes will be stable provided slope gradients do not exceed 2:1 (horizontal to vertical.)

B. Cut Slopes: Cut slopes composed of the gray hard weathered rock may be designed using a slope gradient of 1:1. However for those cut slopes encountered in the yellowish brown weathered rock, slope gradients should be limited to $1\frac{1}{2}$:1 or less. We anticipate that the highest cut slope planned will probably be founded in the gray weathered rock where 1:1 slope gradients may be used. During grading operations, if the material varies from what is expected, slope gradients may need to be redesigned.

We recommend planting of both cut and fill slopes as soon as practical to minimize any erosion and weathering effects.

### II. Groundwater

Groundwater is not anticipated from any of the cut slopes. However requirements for any possible subdrains will be

determined during grading operations.

## III. Bearing Capacity and Settlement

If all brush and organic material is removed prior to placement of fill, settlement of the underlying strata should be negligible.

An allowable bearing value of 4000 PSF may be used for footings founded on the weathered rock material. An allowable bearing value of 2000 PSF may be used for footings founded on fill. All footings should be a minimum of 12 inches in width and embedded 12 inches below the adjacent finished grade.

## IV. Expansive Soils

The onsite soils exhibit only slight volume change potential with changes in moisture content in the remolded state. In its undisturbed state, the soil exhibits moderate swell potential. Therefore, all slabs on grade should be reinforced with 6x6-10x10 welded wire fabric.

## V. Grading

A. Rippability: The major portion of the onsite soils encountered during our investigation indicate that

blasting may be required during grading operations. The lower areas adjacent to the existing subdivision indicate that excavations can be made with conventional earth moving equipment.

B. Embankment Shrinkage: Approximately the upper 2 inches of soil can be expected to be lost during grubbing operations. We anticipate a 1% swell of borrow material of the weathered gray rock.

C. Insitu Moisture Content: The average insitu moisture of the soils is only slightly above optimum moisture. Compaction can be achieved without the need for air drying of the soils.

## VI. Pavement Design

We recommend that the following pavement section be considered in the design of the roadway.

| | |
|---|---|
| 2" | Asphaltic Concrete |
| 6" | Base Course<br>CBR 85% |
| 6" | Select Borrow Sub-base<br>95% Compaction |
| 6" | Prepared Subgrade<br>95% Compaction<br>Scarified in upper<br>6" and recompacted |

## CONCLUSIONS AND RECOMMENDATIONS

1. The site is feasible for the proposed development.

2. Fill slopes should be grossly stable at slope gradients of 2:1 (horizontal to vertical).

3. Cut slopes composed of the gray hard weathered rock may be designed using a slope gradient of 1:1. Where cut slopes encounter the yellowish brown material, slope gradients should be limited to $1\frac{1}{2}$:1 or less.

4. Both cut and fill slopes should be planted as soon as practical to minimize the effects of weathering.

5. The need for subdrains is not anticipated.

6. The settlement of the underlying strata as a result of fill placement is expected to be negligible.

7. An allowable bearing value of 4000 PSF may be used for footings founded on the weathered rock material. An allowable bearing value of 2000 PSF may be used for footings founded on the compacted fill. All footings should be a minimum of 12 inches in width and embedded 12 inches below the adjacent finished grade.

8. The onsite soils are considered only slight to moderately expansive. Therefore, all slabs on grade should be reinforced with 6x6-10x10 welded wire fabric.

9. The major portion of the on site soils will probably require blasting.

10. Approximately the upper 2 inches of soil can be expected to be lost during grubbing operations. We anticipate a 1% swell of borrow material of the weathered gray rock.

11. Compaction can be achieved without the need for air drying of the soils.

12. Onsite soils are suitable for fill material.

13. All trees, roots, brush, and other deleterious materials shall be removed and wasted from the site.

14. Oversize material shall not be placed within 10 feet of finish pad grade nor placed within 10 feet of any slope face.

15. Areas to receive fill which are 5:1 or flatter shall be scarified, watered, mixed, blended, and compacted to at least 90% relative compaction to a depth of 12 inches prior to placing of fill.

16. Fill placed on surfaces which slope steeper than 5:1 shall be keyed and benched.

17. We recommend that any pad which is in both cut and fill material be overcut a thickness equal to the maximum thickness of fill on the pad up to a maximum of three feet and replaced with a uniformly thick blanket of compacted fill.

18. All fill shall be compacted to a minimum of 90% relative compaction as determined by the Modified AASHO T-180.

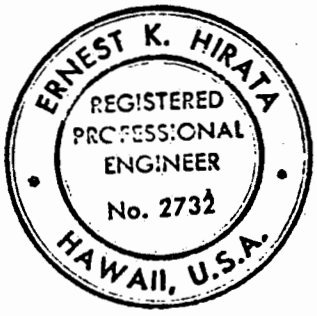
19. We recommend that the flexible pavement design be based on 2 inches of asphaltic concrete with 6 inches of base course material underlain by 6 inches of select borrow sub-base. The subgrade should be compacted to 95% of the maximum density for a minimum depth of 6 inches.

Respectfully submitted,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata P.E. 2732



# APPENDIX OF LABORATORY TESTING

## Classification

The field classification is verified in the laboratory, also in accordance with the Unified Soil Classification System. Laboratory classification is determined by both visual examination and Atterburg Limit Tests according to ASTM D423 and D424. The final classification is shown on the Boring Logs.

## Moisture-Density

The field moisture content and dry unit weight are determined for each of the undisturbed soil samples. The information is useful in providing a gross picture of the soil consistency between borings and any local variations. The dry unit weight is determined in pounds per cubic foot while the moisture content is determined as a percentage of the dry unit weight. These samples are obtained from a 3" O.D. split tube sampler.

## Consolidation

Settlement predictions of the soil's behavior under load are made on the basis of the consolidation tests. Loads are applied in several increments in a geometric progression, and the resulting deformations are recorded at selected time intervals. Porous stones are placed in contact with the top and bottom of each specimen having an inside diameter of 2.40 inches and a height of 1 inch to permit addition and

release of pore fluid. Results of undisturbed and remolded samples are plotted on the Consolidation Test Report.

## Compaction Tests

Compaction tests were performed on bag samples to determine the optimum moisture content at which each type of proposed fill material compacts to 100% density. The tests were performed according to the Modified AASHO T-180.

## Swell Tests

Swell tests were performed to determine the expansiveness of the onsite surface soils. The tests were performed on undisturbed ring and remolded samples taking a one inch high specimen under different surcharge loads.

## Shear Tests

Shear tests are performed in the Direct Shear Machine which is of the strain control type. The rate of deformation is approximately 0.03 inches per minute. Each sample is sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion and angle of internal friction. Eighty percent of the ultimate value is taken to determine the shear strength parameters.

## LABORATORY TEST RESULTS

**Project:** Kailua Heights Unit 6B **W.O.** 140

| Boring or Test Pit No. | B1 | B1 | B2 | B3 | |
|---|---|---|---|---|---|
| Depth (ft.) | 5' | 2'-5' | 2'-7' | 6'-12' | |
| Atterburg Limit Tests | | | | | |
| Liquid Limit | | 43.0 | 24.7 | 31.9 | |
| Plastic Limit | | 31.6 | 22.6 | 24.8 | |
| Plastic Index | | 11.4 | 2.1 | 7.1 | |
| Soil Classification | ML | ML | ML | ML | |
| Expansion @ 90 PSF | | | | | |
| Natural | | | | | |
| Remolded | | 3.7 | | 3.4 | |
| Expansion @700 PSF | | | | | |
| Natural | 1.4 | | | | |
| Remolded | | 1.2 | 0 | 0 | |
| Unconfine Stress (PSF) | | | | | |
| Proctor | | | | | |
| Max. Dry Unit Wt. (PCF) | | 98.0 | 131.0 | 112.5 | |
| Optimum Water (%) | | 23.5 | 12.0 | 16.0 | |
| Wet Density In-Place (PCF) | | | | | |
| Moisture In-Place (%) | 25.0 | | | | |
| Dry Unit Wt. In-Place (PCF) | | | | | |
| Remolded Shear | | | | | |
| ø | | 54° | 40° | 36° | |
| C (KSF) | | 1.23 | 0.89 | 0.67 | |

# ERNEST K. HIRATA & ASSOCIATES INC.

## STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for grading operations performed under the control of Ernest K. Hirata & Associates Inc.

No deviation from these specifications will be allowed, except where specifically superseded in the preliminary soils report, or in other written communication signed by the Soils Engineer.

### I. GENERAL

A. The Soils Engineer is the Owner's or Builder's representative on the project. For the purpose of these specifications, supervision by the Soils Engineer includes that inspection performed by any person or persons employed by, and responsible to, the licensed Civil Engineer signing the soils report.

B. All clearing, site preparation or earthwork performed on the project shall be conducted by the Contractor under the supervision of the Soils Engineer.

C. It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Soils Engineer and to place, spread, mix, water and compact the fill in accordance with the specifications of the Soils Engineer. The Contractor shall also remove all material considered unsatisfactory by the Soils Engineer.

D. It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of compaction. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement and time of year.

E. A final report shall be issued by the Soils Engineer attesting to the Contractor's conformance with these specifications.

## II. SITE PREPARATION

A. All vegetation and deleterious material such as rubbish shall be disposed of offsite. This removal must be concluded prior to placing fill.

B. Soil, alluvium or rock materials determined by the Soils Engineer as being unsuitable for placement in compacted fills shall be removed and wasted from the site. Any material incorporated as a part of a compacted fill must be approved by the Soils Engineer.

C. After the ground surface to receive fill has been cleared, it shall be scarified, disced or bladed by the Contractor until it is uniform and free from ruts, hollows, hummocks or other uneven features which may prevent uniform compaction.

The scarified ground surface shall then be brought to optimum moisture, mixed as required, and compacted as specified. If the scarified zone is greater than twelve inches in depth, the excess shall be removed and placed in lifts restricted to six inches.

Prior to placing fill, the ground surface to receive fill shall be inspected, tested and approved by the Soils Engineer.

D. Any underground structures such as cesspools, cisterns, tunnels, septic tanks, wells, pipelines or others not located prior to grading are to be removed or treated in a manner prescribed by the Soils Engineer.

## III. COMPACTED FILLS

A. Any material imported or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Soils Engineer. Roots, tree branches and other matter missed during clearing shall be removed from the fill as directed by the Soils Engineer.

B. Rock fragments less than six inches in diameter may be utilized in the fill, provided:

1. They are not placed in concentrated pockets.

2. There is a sufficient percentage of fine-grained material to surround the rocks.

3. The distribution of the rocks is supervised by the Soils Engineer.

C. Rocks greater than six inches in diameter shall be taken offsite, or placed in accordance with the recommendations of the Soils Engineer in areas designated as suitable for rock disposal.

D. Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.

E. Representative samples of materials to be utilized as compacted fill shall be analyzed in the laboratory by the Soils Engineer to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Soils Engineer as soon as possible.

F. Material used in the compacting process shall be evenly spread, watered, processed and compacted in thin lifts not to exceed six inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Soils Engineer.

G. If the moisture content or relative density varies from that required by the Soils Engineer, the Contractor shall rework the fill until it is approved by the Soils Engineer.

H. Each layer shall be compacted to 90 percent of the maximum density in compliance with the testing method specified by the controlling governmental agency.

If compaction to a lesser percentage is authorized by the controlling governmental agency because of a specific land use or expansive soil conditions, the area to receive fill compacted to less than 90 percent shall either be delineated on the grading plan or appropriate reference made to the area in the soil report.

I. All fills shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of five horizontal to one vertical, in accordance with the recommendations of the Soils Engineer.

J. The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the soils report.

K. Drainage terraces and subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, or with the recommendations of the Soils Engineer.

L. The Contractor will be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction.

If a method other than overbuilding and cutting back to the compacted core is to be employed, slope tests will be made by the Soils Engineer during construction of the slopes to determine if the required compaction is being achieved. Where failing tests occur or other field problems arise, the Contractor will be notified of such conditions by written communication from the Soils Engineer in the form of a conference memorandum, to avoid any misunderstanding arising from oral communication.

If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor shall rework or rebuild such slopes until the required degree of compaction is obtained, at no additional cost to the Owner or Soils Engineer.

M. All fill slopes should be planted or protected from erosion by methods specified in the soils report.

N. Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials; and the transition shall be stripped of all soil prior to placing fill.

## IV. CUT SLOPES

A. If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature are encountered during grading, these conditions shall be analyzed by the Soils Engineer; and recommendations shall be made to treat these problems.

B. Unless otherwise specified in the soils report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

C. Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Soils Engineer.

## V. GRADING CONTROL

A. Inspection of the fill placement shall be provided by the Soils Engineer during the progress of grading.

B. In general, density tests shall be made at intervals not exceeding two feet of fill height of every 500 cubic yards of fill placed. This criteria will vary

depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction is being achieved.

C. Density tests shall also be made on the surface material to receive fill as required by the Soils Engineer.

D. All cleanout, processed ground to receive fill, key excavations, subdrains and rock disposal must be inspected and approved by the Soils Engineer prior to placing any fill. It shall be the Contractor's responsibility to notify the Soils Engineer when such areas are ready for inspection.

## VI. CONSTRUCTION CONSIDERATIONS

A. Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

B. Upon completion of grading and termination of inspections by the Soils Engineer, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Soils Engineer.

C. Care shall be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.

# ERNEST K. HIRATA & ASSOC.

## BORING LOG

BORING NO. B1 DRIVING WT. 140 lb. DATE OF DRILLING 3-13-72

SURFACE ELEV. 145 ± DROP 30 in. W.O. 140

| DEPTH FEET | CORE | BAG | PENE. RESIST. BLOWS/FOOT | DRY DENSITY PCF | MOISTURE CONTENT % | RELATIVE COMPACTION % | DIRECT SHEAR STRENGTH PARAMETERS ø | DIRECT SHEAR STRENGTH PARAMETERS C | CLASSIFICATION (% Sand, % Silt, % Clay) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Silty CLAY (ML) - Mottled brown, with some gravel |
| 5 | x | | 50/5" | | 25.0 | | | | Weathered Rock - Gray, hard |
| | x | | 50/2" | | | | | | |
| 10 | | | | | | | | | End boring at 9 feet. |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

Plate A1

# ERNEST K. HIRATA & ASSOC.

## BORING LOG

BORING NO. B2 DRIVING WT. 140 lb. DATE OF DRILLING 3-13-72

SURFACE ELEV. 75 ± DROP 30 in. W.O. 140

| DEPTH FEET | CORE | BAG | PENE. RESIST. BLOWS/FOOT | DRY DENSITY PCF | MOISTURE CONTENT % | RELATIVE COMPACTION % | DIRECT SHEAR STRENGTH PARAMETERS ø | DIRECT SHEAR STRENGTH PARAMETERS c | CLASSIFICATION (% Sand, % Silt, % Clay) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Clayey SILT (ML) - Brown, with gravel and cobbles. |
| 5 | x | | 20/0" | | | | | | Weathered Rock - Mottled gray, hard. |
| 10 | x | | 25/0" | | | | | | Rock - Purplish gray, hard |
| | | | | | | | | | End boring at 10 feet. |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

Plate A2

# ERNEST K. HIRATA & ASSOC.

## BORING LOG

BORING NO. B3 DRIVING WT. 140 lb. DATE OF DRILLING 3-13-72

SURFACE ELEV. 85 ± DROP 30 in. W.O. 140

| DEPTH FEET | CORE | BAG | PENE. RESIST. BLOWS/FOOT | DRY DENSITY PCF | MOISTURE CONTENT % | RELATIVE COMPACTION % | DIRECT SHEAR STRENGTH PARAMETERS ø | DIRECT SHEAR STRENGTH PARAMETERS C | CLASSIFICATION (% Sand, % Silt, % Clay) |
|---|---|---|---|---|---|---|---|---|---|
| 5 | x | | 14<br>27<br>32 | 100.1 | 19.8 | | | | Silty CLAY (ML) - Brown, with cobbles |
| 10 | x | | 31<br>35/3" | 86.9 | 11.1 | | | | Weathered Rock - Mottled yellow, hard. |
| 15 | x | | 20/0" | | | | | | End boring at 15 feet. |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

Plate A3

# ERNEST K. HIRATA & ASSOC.

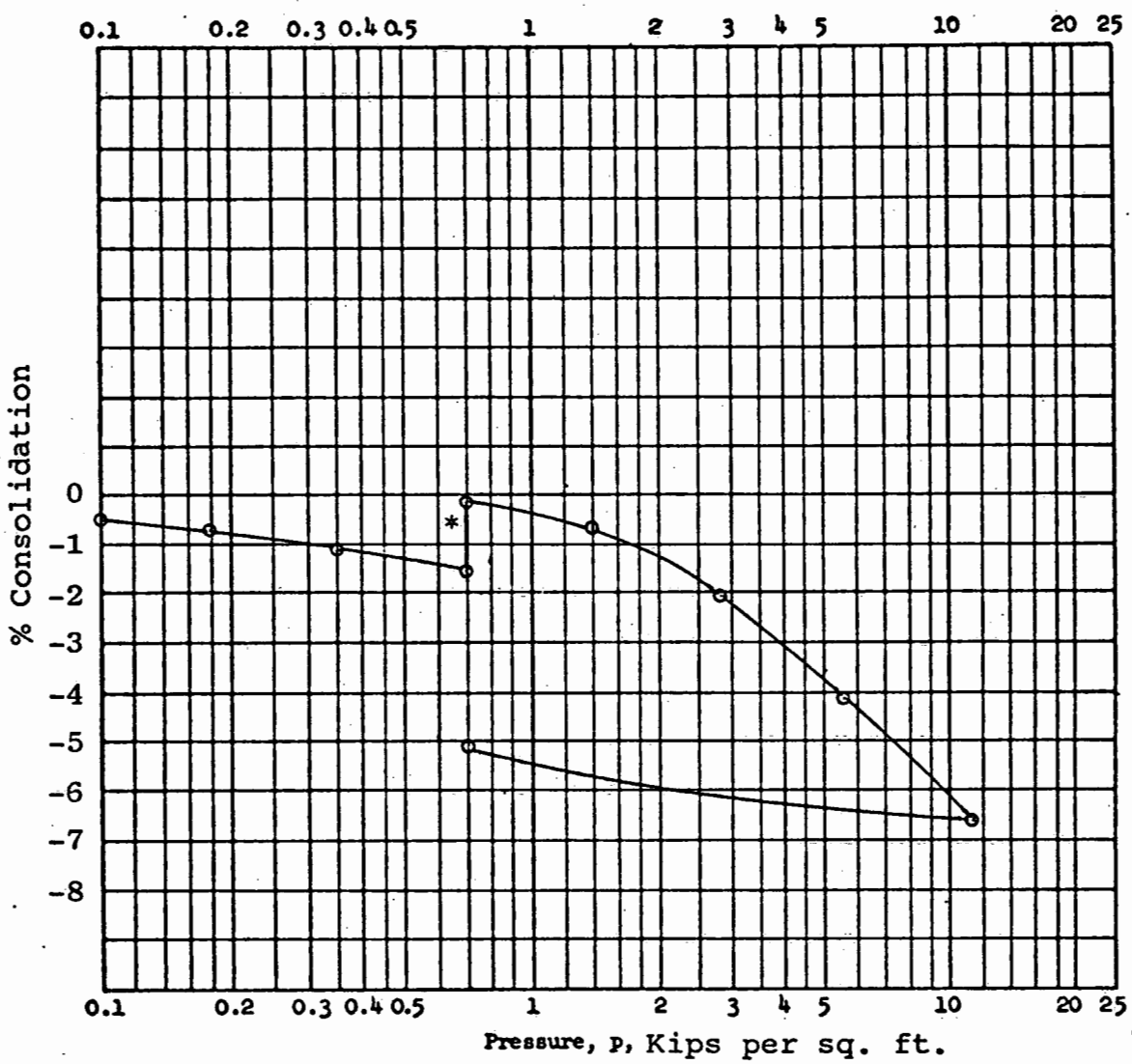
## BORING LOG

BORING NO. B4 DRIVING WT. 140 lb. DATE OF DRILLING 3-13-72

SURFACE ELEV. 57 ± DROP 30 in. W.O. 140

| DEPTH FEET | CORE | BAG | PENE. RESIST. BLOWS/FOOT | DRY DENSITY PCF | MOISTURE CONTENT % | RELATIVE COMPACTION % | DIRECT SHEAR STRENGTH PARAMETERS ø | DIRECT SHEAR STRENGTH PARAMETERS C | CLASSIFICATION (% Sand, % Silt, % Clay) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | Silty CLAY (ML) - Brown, stiff |
| 5 | x | | 30<br>44 | 92.9 | 9.6 | | | | Weathered Rock - Mottled yellow, firm |
| 10 | x | | 40/4" | | | | | | End boring at 10.3 feet. |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

Plate A4

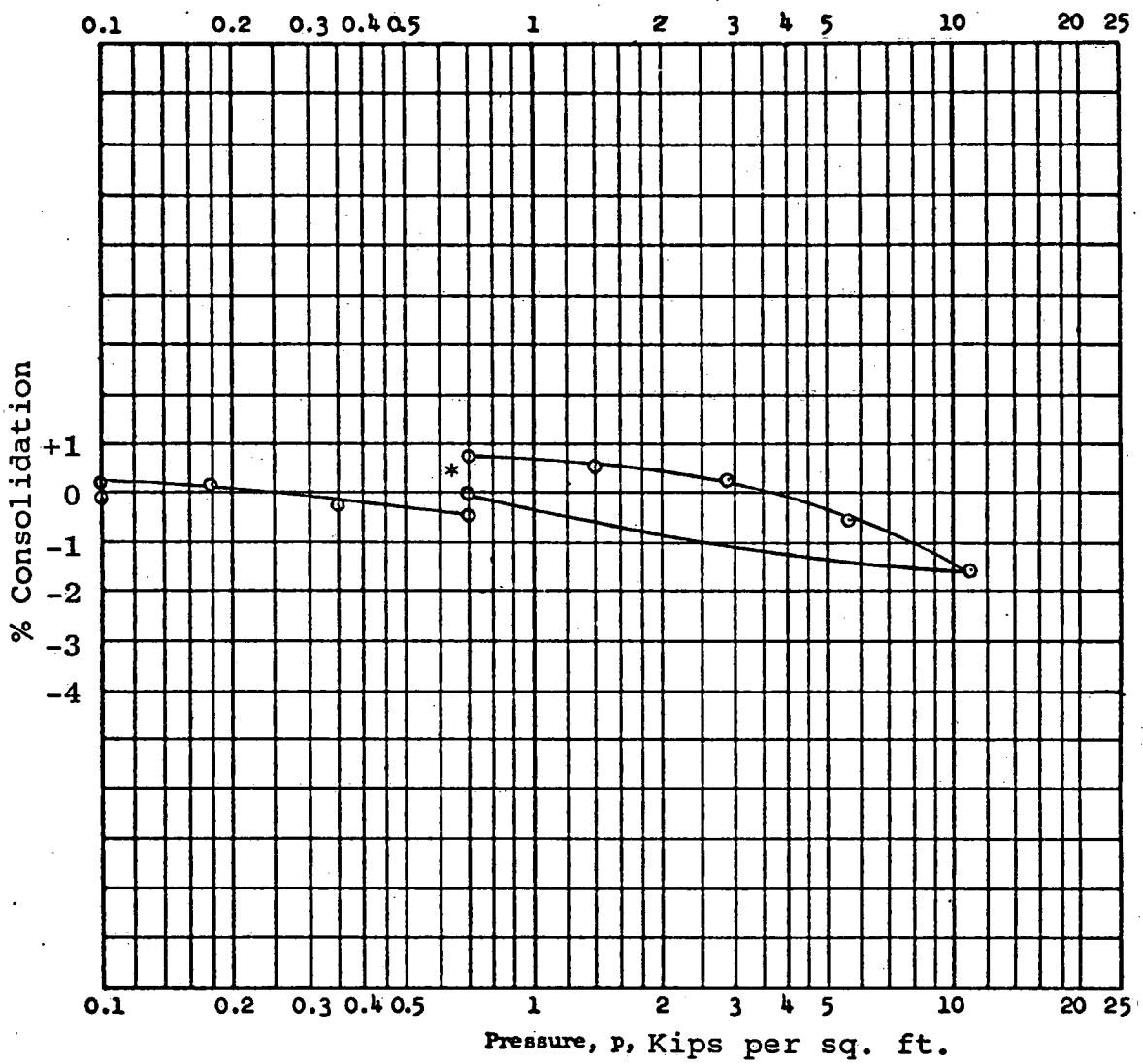



| | | | | | |
|---|---|---|---|---|---|
| Type of Specimen | Undisturbed | Before Test | | After Test | |
| Diam 2.40 in. | Ht 1.0 in. | Water Content, $w_o$ | 25.0% | $w_f$ | 44.4% |
| Overburden Pressure, $p_o$ | T/sq ft | Void Ratio, $e_o$ | | $e_f$ | |
| Preconsol. Pressure, $p_c$ | T/sq ft | Saturation, $S_o$ | % | $S_f$ | % |
| Compression Index, $C_c$ | | Dry Density, $\gamma_d$ | lb/ft$^3$ | | |
| Classification | | $k_{20}$ at $e_o$ = | x 10$^-$ cm/sec | | |
| LL | $G_s$ | Project Kailua Heights Unit 6B | | | |
| PL | $D_{10}$ | W.O. 140 | | | |
| Remarks * Water added at 700 PSF. | | Area | | | |
| | | Boring No. B1 | Sample No. | | |
| | | Depth 5' El | Date 3-30-72 | | |
| | | CONSOLIDATION TEST REPORT | | | |

ENG FORM 2090
1 MAY 63

0 3424

Plate B1

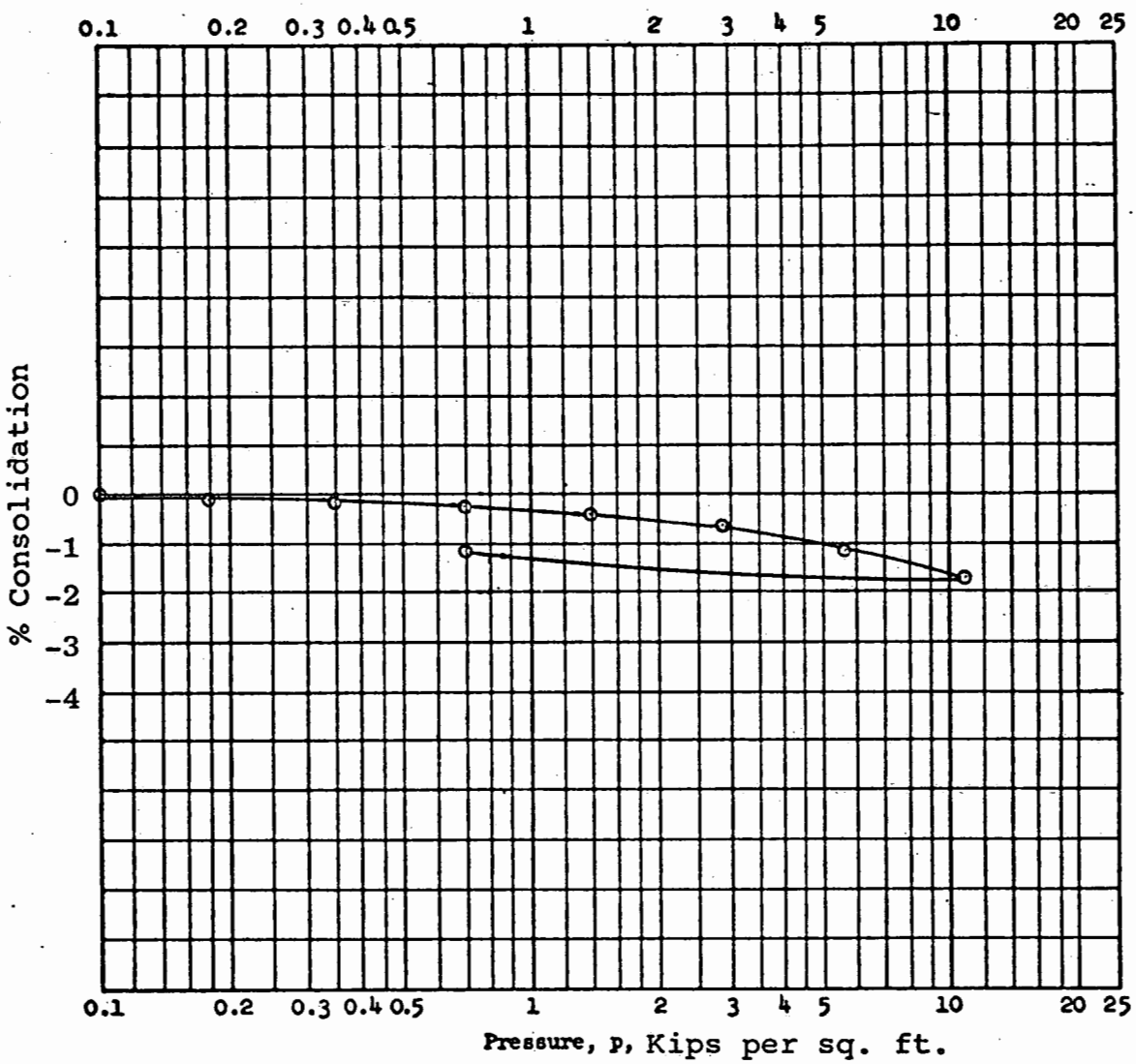



| | | | | | |
|---|---|---|---|---|---|
| Type of Specimen: Remolded | | Before Test | | After Test | |
| Diam 2.40 in. | Ht 1.0 in. | Water Content, $w_o$ | 25.0 % | $w_f$ | 34.6 % |
| Overburden Pressure, $p_o$ T/sq ft | | Void Ratio, $e_o$ | | $e_f$ | |
| Preconsol. Pressure, $p_c$ T/sq ft | | Saturation, $S_o$ | % | $S_f$ | % |
| Compression Index, $C_c$ | | Dry Density, $\gamma_d$ | lb/ft$^3$ | | |
| Classification ML | | $k_{20}$ at $e_o$ = | x 10$^-$ cm/sec | | |
| LL 43.0 | $G_s$ | Project Kailua Heights Unit 6B | | | |
| PL 31.6 | $D_{10}$ | W.O. 140 | | | |
| Remarks * Water added at 700 PSF | | Area | | | |
| | | Boring No. B1 | Sample No. | | |
| | | Depth El 2-5' | Date 3-24-72 | | |
| | | CONSOLIDATION TEST REPORT | | | |

ENG FORM 2090
1 MAY 63

0 3424

Plate B2




| | | | | | |
|---|---|---|---|---|---|
| Type of Specimen | Remolded | Before Test | | After Test | |
| Diam 2.40 in. | Ht 1.0 in. | Water Content, $w_o$ | 12.4% | $w_f$ | 16.0% |
| Overburden Pressure, $p_o$ | T/sq ft | Void Ratio, $e_o$ | | $e_f$ | |
| Preconsol. Pressure, $p_c$ | T/sq ft | Saturation, $S_o$ | % | $S_f$ | % |
| Compression Index, $C_c$ | | Dry Density, $\gamma_d$ | lb/ft$^3$ | | |
| Classification | ML | $k_{20}$ at $e_o$ = | x 10$^-$ cm/sec | | |
| LL 24.7 | $G_s$ | Project | Kailua Heights Unit 6B | | |
| PL 22.6 | $D_{10}$ | | W.O. 140 | | |
| Remarks | Water added at 700 PSF | Area | | | |
| | | Boring No. | B2 | Sample No. | |
| | | Depth El | 2-7' | Date | 3-22-72 |

CONSOLIDATION TEST REPORT

ENG FORM 2090
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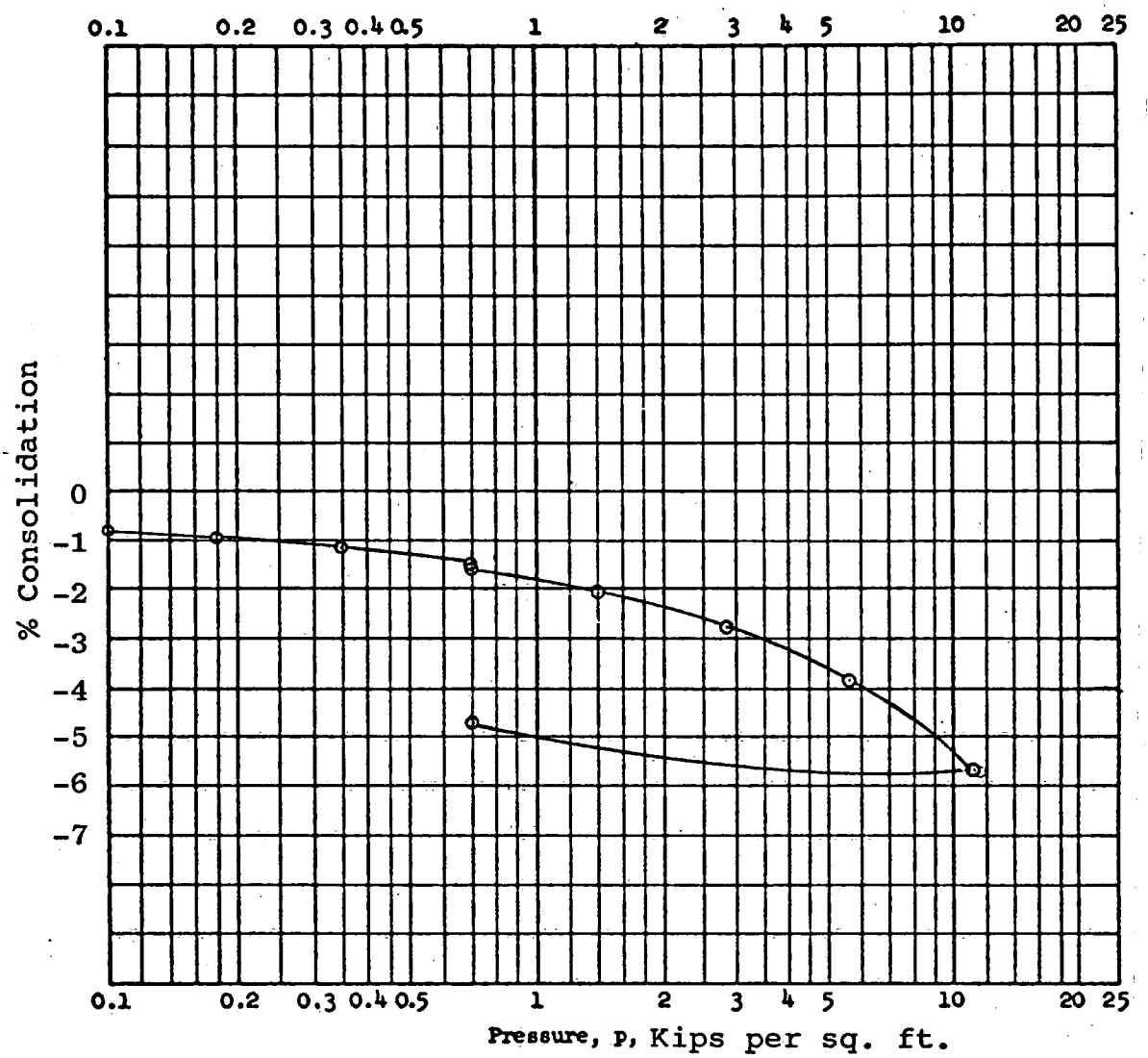
0 3424

Plate B3




| | | | | | |
|---|---|---|---|---|---|
| Type of Specimen: Remolded | | Before Test | | After Test | |
| Diam 2.40 in. | Ht 1.0 in. | Water Content, $w_o$ | 17.3 % | $w_f$ | 24.9 % |
| Overburden Pressure, $p_o$ T/sq ft | | Void Ratio, $e_o$ | | $e_f$ | |
| Preconsol. Pressure, $p_c$ T/sq ft | | Saturation, $S_o$ | % | $S_f$ | % |
| Compression Index, $C_c$ | | Dry Density, $\gamma_d$ | lb/ft$^3$ | | |
| Classification | | $k_{20}$ at $e_o$ = | x 10$^-$ cm/sec | | |
| LL 31.9 | $G_s$ | Project Kailua Heights Unit 6B | | | |
| PL 24.8 | $D_{10}$ | W.O. 140 | | | |
| Remarks Water added at 700 PSF | | Area | | | |
| | | Boring No. B3 | | Sample No. | |
| | | Depth / El 6-12' | | Date 3-22-72 | |
| | | CONSOLIDATION TEST REPORT | | | |

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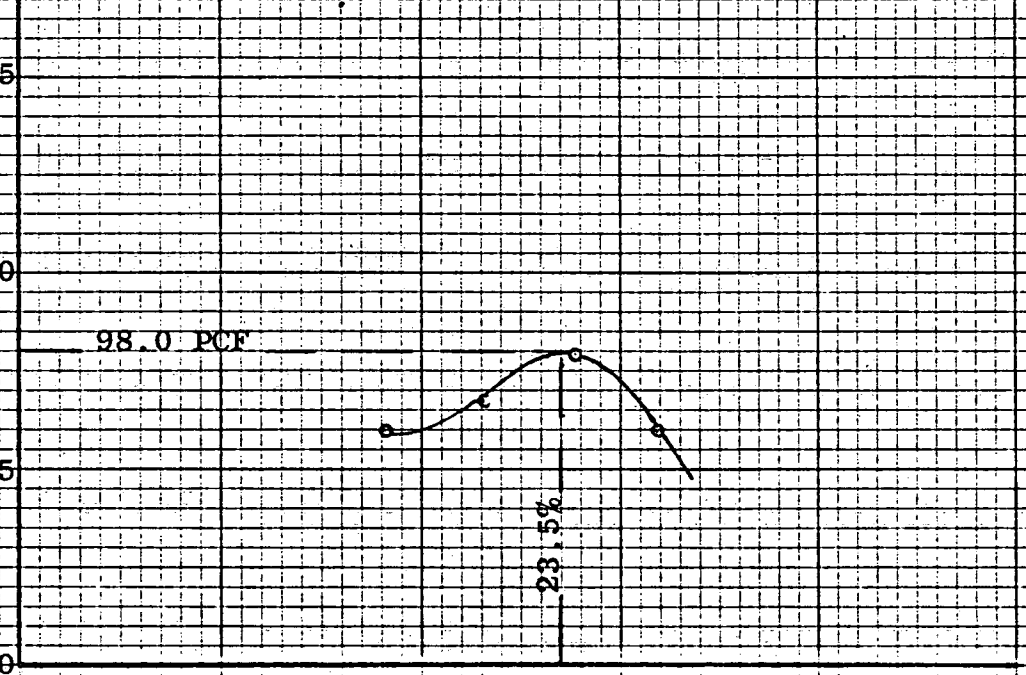
Plate B4

MAXIMUM DENSITY CURVE




Boring: B1

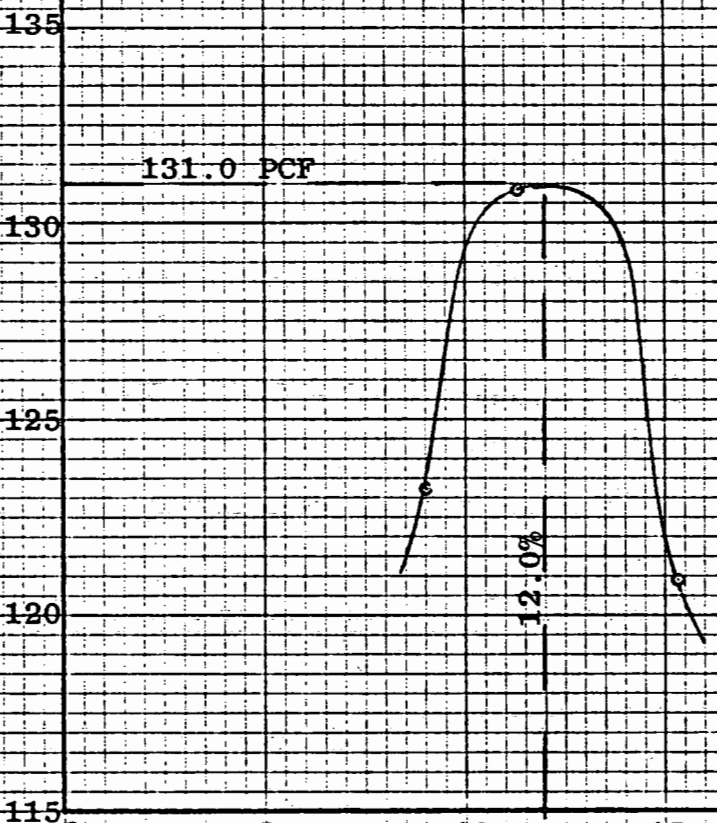
Depth: 2'-5'

Classification: ML Gray-Brown O.M. 140

P.L. = 43.0
L.L. = 31.6
P.I. = 11.4

Plate C1

MAXIMUM DENSITY CURVE




Boring: B2

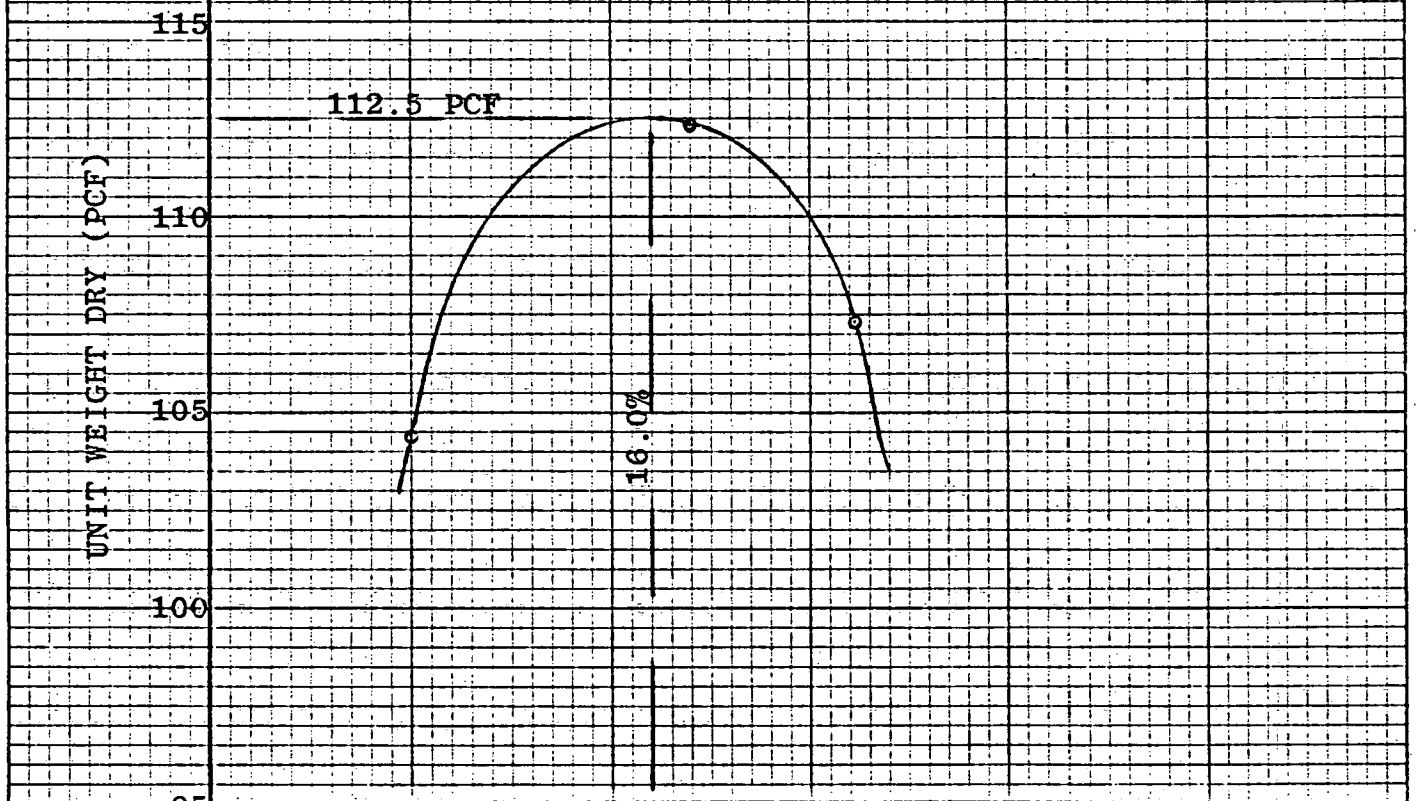
Depth: 2'-7'

Classification: ML Brown Sandy Silt

L.L. = 24.7
P.L. = 22.6
P.I. = 2.1

T.O. 140

MAXIMUM DENSITY CURVE



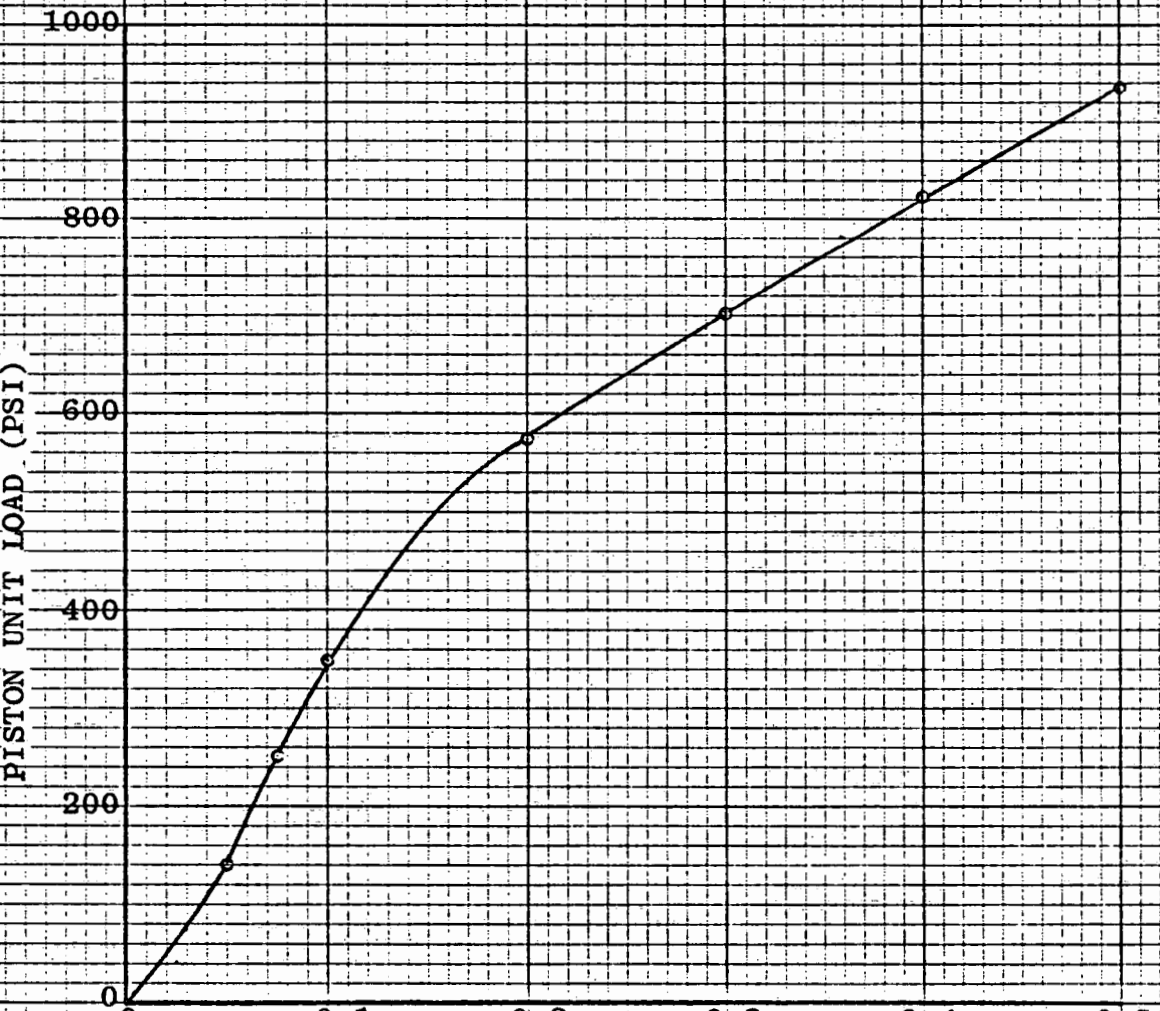

Boring: B3

Depth: 6'-12'

Classification: ML Mottled yellow Clayey Silt W.O. 140

L.L. = 31.9
P.L. = 24.8
P.I. = 7.1

## CBR TEST RESULTS




Boring: B3

Depth: 6'-12'

Classification: ML W.O. 140

CBR = 34.0 Max. Density = 112.5 PCF

Swell = 2.5% Optimum Moisture = 16.0%

G.P. # 5689

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering
1236 South King Street • Honolulu, Hawaii 96814 • Phone 531-5733

for grading
for Jackson
Apartments

February 7, 1974
W.O. 140-A

Lone Star Hawaii, Inc.
1020-E Keolu Drive
Kailua, Oahu, Hawaii 96734

Attention: Mr. Michael Sell

Subject: Supervised Compacted Fill Report
Kailua Heights Unit 6B
Kailua, Oahu, Hawaii

Gentlemen:

Submitted herewith is a compacted fill report on the above referenced project. The purpose of the testing was to determine that the specifications required by the revised ordinances of the City & County of Honolulu met compliance. The field density test results are presented in Table I. The approximate test locations are shown on the accompanying grading plan.

| SOIL TYPE | SOIL DESCRIPTION | MAXIMUM DRY DENSITY (PCF) | OPTIMUM MOISTURE |
|---|---|---|---|
| GM | Gray Silty Gravel | 127.0 | 12.5 |
| ML | Brown Sandy Silt | 110.5 | 17.0 |

The maximum density and optimum moisture content of each soil type utilized were determined in accordance with ASTM D-1557-70T.

Field density tests were performed in accordance with the Sand-Cone Method (ASTM D-1556-64).



Rec 2/15/74

## DISCUSSION

1. All deleterious materials such as brush, rubbish, etc. were disposed of offsite prior to placing fill.

2. The exposed ground surface was scarified to a depth of 6 inches, moistened or dried as required to achieve optimum moisture conditions, and recompacted to 90% of the laboratory standard.

3. Fill was placed in lifts restricted to 6 inches in thickness, moistened or dried as required, and compacted with vibratory compactors to 90% or better as indicated by the test results.

Respectfully submitted,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata P.E. 2732

EKH:ph

# TABLE I

## DENSITY TEST RESULTS

| DATE | TEST NO. | LOT NO. | ELEV. | DENSITY (PCF) | MOISTURE CONTENT | MAX. DENSITY | % COMP. | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 11-15-72 | D1 | 13 | 62.0 | 116.5 | 11.1 | 127.0 | 91.8 | |
| 12-14-72 | D2 | 13 | 64.0 | 116.1 | 12.0 | 127.0 | 91.4 | |
| 1-12-73 | D3 | 13 | 68.0 | 122.7 | 10.5 | 127.0 | 96.7 | |
| 1-17-73 | D4 | 13 | 77.7 | 114.7 | 12.7 | 127.0 | 90.3 | |
| 11-20-73 | D5 | 13 | 86.4 | 124.3 | 11.1 | 127.0 | 97.9 | |
| | D6 | 14 | 80.5 | 117.3 | 10.8 | 127.0 | 92.3 | |
| | D7 | 13 | 76.3 | 124.4 | 11.7 | 127.0 | 98.0 | |
| | D8 | 14 | 70.8 | 117.4 | 11.1 | 127.0 | 92.4 | |
| | D9 | 12 | 94.6 | 116.9 | 12.7 | 127.0 | 92.0 | |
| | D10 | 12 | 85.2 | 117.1 | 13.0 | 127.0 | 92.2 | |
| | D11 | 11 | 103.2 | 116.0 | 12.4 | 127.0 | 91.3 | |
| | D12 | 11 | 93.0 | 117.6 | 12.7 | 127.0 | 92.6 | |
| | D13 | 10 | 108.3 | 107.8 | 13.0 | 110.5 | 97.5 | |
| | D14 | 10 | 95.2 | 107.5 | 13.6 | 110.5 | 97.3 | |